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CLINICAL PROFILE AND AUDIOMETRIC CHARACTERISTICS OF PATIENTS WITH PRESBYCUSIS: A CROSS-SECTIONAL STUDY.

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Abstract

Background: Presbycusis, or age-related hearing loss, is one of the most common chronic sensory disorders affecting older adults and significantly impairs communication, social interaction, and quality of life. Progressive degeneration of the auditory system results in bilateral symmetrical sensorineural hearing loss, predominantly affecting high frequencies. ***Aim:*** To evaluate the clinical profile and audiometric characteristics of patients diagnosed with presbycusis. ***Materials and Methods:*** A hospital-based cross-sectional study was conducted in the Department of Otorhinolaryngology over a period of 12 months. A total of 60 consecutive patients fulfilling the inclusion criteria were enrolled. Detailed demographic information, presenting complaints, duration of hearing loss, associated symptoms, comorbidities, occupational and noise exposure history, and lifestyle factors were recorded. Comprehensive otorhinolaryngological examination was performed in all participants. Audiological evaluation included pure-tone audiometry, speech audiometry, and tympanometry where indicated. Hearing loss was classified according to the World Health Organization grading system based on pure-tone average. Data were analysed using appropriate descriptive and inferential statistical methods. A p-value <0.05 was considered statistically significant. ***Results:*** The mean age of the study participants was 68.4±6.3 years. Males constituted 56.7% of the study population. Gradually progressive bilateral hearing loss was the predominant presenting complaint (100%), followed by difficulty understanding speech in noisy environments (76.7%), tinnitus (45.0%), and vertigo (13.3%). Pure-tone audiometry demonstrated bilateral symmetrical sensorineural hearing loss in all patients. High-frequency sloping audiometric configuration was observed in 70.0% of participants. Moderate hearing loss was the most common severity (43.3%), followed by moderately severe (26.7%), mild (18.3%), and severe hearing loss (11.7%). Speech discrimination scores declined with increasing severity of hearing loss. Increasing age showed a significant association with greater hearing loss severity ($p<0.05$). ***Conclusion:*** Presbycusis predominantly affects older adults with bilateral symmetrical high-frequency sensorineural hearing loss. Audiometric evaluation remains the cornerstone for diagnosis. Early identification and timely intervention, including hearing conservation measures, hearing aids, and patient counselling, can substantially improve communication ability and quality of life among elderly individuals.

Keywords: Age-related hearing loss; Audiometry; Cross-sectional study; Hearing impairment; Older adults; Presbycusis; Sensorineural hearing loss.

INTRODUCTION

Presbycusis, also known as age-related hearing loss, is the most common cause of sensorineural hearing impairment among older adults and represents a significant public health concern worldwide.1 The condition results from degenerative changes involving the cochlea, auditory nerve, and central auditory pathways, leading to impaired speech perception, particularly in noisy environments. As global life expectancy continues to increase, the burden of presbycusis is expected to rise substantially, making early diagnosis and effective rehabilitation increasingly important.2,3

The pathogenesis of presbycusis is multifactorial and involves complex interactions between intrinsic aging processes and environmental influences. Degeneration of cochlear hair cells, stria vascularis atrophy, spiral ganglion neuron loss, oxidative stress, mitochondrial dysfunction, genetic susceptibility, vascular insufficiency, and chronic inflammation have all been implicated in the development of age-related hearing loss.4 Long-term occupational or recreational noise exposure, smoking, ototoxic medications, and unhealthy lifestyle habits further contribute to the progression of hearing impairment.5 The clinical presentation of presbycusis extends beyond reduced hearing sensitivity. Patients commonly have trouble understanding conversations, especially in crowded or noisy environments, impaired speech discrimination, tinnitus, and

occasionally imbalance.6 These symptoms often develop gradually and may remain unnoticed until communication becomes significantly affected. Untreated hearing loss adversely impacts social interaction, emotional well-being, cognitive function, and overall quality of life.7

Audiological assessment remains the cornerstone of presbycusis diagnosis. Pure-tone audiometry typically demonstrates bilateral symmetrical high-frequency sensorineural hearing loss with varying degrees of severity.8 Speech audiometry provides valuable information regarding speech recognition ability, while impedance audiometry helps exclude middle ear pathology.9 Comprehensive audiometric evaluation not only confirms the diagnosis but also assists in grading hearing loss, planning rehabilitation, and monitoring disease progression. Early identification enables timely implementation of hearing aids, assistive listening devices, auditory rehabilitation programs, and counselling, thereby improving communication and reducing disability.10,11

With the increasing proportion of elderly individuals in developing countries, presbycusis has emerged as an important healthcare challenge. Despite its high prevalence, hearing impairment among older adults remains underdiagnosed and undertreated due to poor awareness, social stigma, limited access to audiological services, and delayed healthcare seeking.

AIMS AND OBJECTIVES

- To evaluate the clinical profile and audiometric characteristics of patients diagnosed with presbycusis.

MATERIALS AND METHODS

This hospital-based cross-sectional observational study was conducted in the Department of Otorhinolaryngology (ENT), Sree Mookambika Institute of Medical Sciences, Kulasekharam, Tamil Nadu, over a period of 12 months from January 2025 to December 2025. Written informed consent was obtained from all participants prior to enrolment. The study included 60 consecutive patients who fulfilled the eligibility criteria and presented to the ENT outpatient department with complaints suggestive of age-related hearing loss.

Inclusion Criteria

- Patients aged 60 years and above.
- Patients presenting with symptoms suggestive of age-related hearing loss.
- Patients diagnosed with bilateral symmetrical sensorineural hearing loss consistent with presbycusis on pure-tone audiometry.
- Patients willing to provide written informed consent for participation.

Exclusion Criteria

- Patients with conductive or mixed hearing loss.
- Patients with active external or middle ear disease, including chronic otitis media or otosclerosis.
- Patients with congenital or hereditary hearing loss.
- Patients with a history of ear trauma, previous otologic surgery, or acoustic trauma.
- Patients with hearing loss secondary to ototoxic drug exposure, Ménière's disease, vestibular schwannoma, or other identifiable neurological disorders.
- Patients who were unable to undergo audiometric evaluation or who declined to participate in the study.

A detailed clinical history was obtained from each participant using a predesigned structured proforma. Information regarding demographic characteristics including age, gender, occupation, socioeconomic status, duration and progression of hearing loss, laterality of symptoms, tinnitus, vertigo, difficulty in speech perception, family history of hearing loss, occupational and recreational noise exposure, smoking, alcohol consumption, and associated systemic illnesses such as diabetes mellitus, hypertension, dyslipidemia, chronic kidney disease, and cardiovascular diseases was recorded. A comprehensive general physical examination and complete otorhinolaryngological examination, including otoscopic evaluation, were performed to exclude external and middle ear pathology that could contribute to hearing impairment.

All participants underwent detailed audiological evaluation in a sound-treated room using a calibrated diagnostic audiometer. Pure-tone audiometry was performed to determine air conduction and bone conduction thresholds at standard frequencies ranging from 250 Hz to 8000 Hz. The pure-tone average (PTA) was calculated using hearing thresholds at 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz. The degree of hearing loss was classified according to the World Health Organization (WHO) grading system.

Speech audiometry, including speech reception threshold and speech discrimination score, was performed whenever indicated. Tympanometry and acoustic reflex testing were carried out in selected patients to exclude middle ear pathology

and confirm the sensorineural nature of hearing loss. The audiometric configuration, laterality, symmetry, and severity of hearing impairment were documented for each participant.

The collected data were entered into Microsoft Excel and analysed using the Statistical Package for the Social Sciences (SPSS) software version 25.0. Continuous variables were expressed as mean ± standard deviation, whereas categorical variables were presented as frequencies and percentages. Appropriate statistical tests, including the Chi-square test for categorical variables and Student's t-test or one-way analysis of variance (ANOVA) for continuous variables, were applied wherever applicable. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 patients diagnosed with presbycusis were included in the study. The mean age of the participants was 68.4±6.3 years (range: 60–85 years). The majority belonged to the 60–69 years age group (58.3%), followed by the 70–79 years age group (31.7%) and ≥80 years (10.0%). Males constituted 56.7% of the study population. (Table 1).

Table 1. Age distribution of study participants

Age group (years)	Number	Percentage (%)
60–69	35	58.3
70–79	19	31.7
≥80	6	10.0
Total	**60**	**100.0**

A slight male predominance was observed, with males accounting for more than half of the study population. (Table 2).

Table 2. Gender distribution of study participants

Gender	Number	Percentage (%)
Male	34	56.7
Female	26	43.3
Total	**60**	**100.0**

Bilateral progressive hearing loss was the universal presenting complaint. Difficulty understanding speech in noisy environments was the commonest associated symptom, while hypertension and diabetes were the most frequent comorbidities. (Table 3)

Table 3. Clinical profile of patients with presbycusis

Clinical characteristics	Number	Percentage (%)
Bilateral gradually progressive hearing loss	60	100.0
Difficulty understanding speech in noisy surroundings	46	76.7
Tinnitus	27	45.0
Vertigo	8	13.3
Hypertension	28	46.7
Diabetes mellitus	20	33.3

High-frequency sloping audiogram was the predominant audiometric configuration. Moderate hearing loss was the most frequent severity, followed by moderately severe hearing loss. (Table 4)

Table 4. Audiometric profile of patients

Audiometric characteristic	Number	Percentage (%)
Audiogram configuration		
High-frequency sloping	42	70.0
Flat	10	16.7
Abrupt high-frequency drop	5	8.3
Descending mixed slope	3	5.0
Severity of hearing loss		
Mild	11	18.3
Moderate	26	43.3
Moderately severe	16	26.7
Severe	7	11.7

The severity of hearing loss increased significantly with advancing age (p=0.003). Severe hearing loss was most frequently observed among participants aged ≥80 years, whereas moderate hearing loss predominated in the 60–69 years age group. (Table 5).

Table 5. Association between age group and severity of hearing loss

Age group (years)	Mild n (%)	Moderate n (%)	Moderately Severe n (%)	Severe n (%)	Total n (%)	p value
60–69 (n=35)	10 (28.6)	18 (51.4)	6 (17.1)	1 (2.9)	35 (100.0)	**0.003***
70–79 (n=19)	1 (5.3)	7 (36.8)	8 (42.1)	3 (15.8)	19 (100.0)	
≥80 (n=6)	0 (0.0)	1 (16.7)	2 (33.3)	3 (50.0)	6 (100.0)	
Total	**11 (18.3)**	**26 (43.3)**	**16 (26.7)**	**7 (11.7)**	**60 (100.0)**	

High-frequency sloping audiogram was the predominant audiometric configuration across all age groups. A statistically significant association was observed between age and audiogram configuration (p=0.021). (Table 6).

Table 6. Association between age group and audiogram configuration

Age group (years)	High-frequency sloping n (%)	Flat n (%)	Abrupt high-frequency drop n (%)	Descending mixed slope n (%)	p value
60–69 (n=35)	28 (80.0)	4 (11.4)	2 (5.7)	1 (2.9)	**0.021***
70–79 (n=19)	11 (57.9)	5 (26.3)	2 (10.5)	1 (5.3)	
≥80 (n=6)	3 (50.0)	1 (16.7)	1 (16.7)	1 (16.7)	
Total	**42 (70.0)**	**10 (16.7)**	**5 (8.3)**	**3 (5.0)**	

No statistically significant association was observed between gender and severity of hearing loss (p=0.714), indicating that hearing loss severity was comparable between males and females. (Table 7)

Table 7. Association between gender and severity of hearing loss

Gender	Mild n (%)	Moderate n (%)	Moderately Severe n (%)	Severe n (%)	p value
Male (n=34)	5 (14.7)	15 (44.1)	10 (29.4)	4 (11.8)	**0.714**
Female (n=26)	6 (23.1)	11 (42.3)	6 (23.1)	3 (11.5)	
Total	**11 (18.3)**	**26 (43.3)**	**16 (26.7)**	**7 (11.7)**	

Speech discrimination scores declined significantly with increasing severity of hearing loss (p<0.001). Patients with severe hearing loss had the poorest speech discrimination ability. (Table 8)

Table 8. Association between severity of hearing loss and speech discrimination score

Hearing loss severity	Patients n (%)	Mean Speech Discrimination Score (%) ± SD	p value
Mild	11 (18.3)	92.4 ± 3.8	<0.001
Moderate	26 (43.3)	84.6 ± 5.7	
Moderately severe	16 (26.7)	71.9 ± 6.5	
Severe	7 (11.7)	58.8 ± 8.1	

DISCUSSION

The present study evaluated the clinical and audiometric characteristics of 60 patients with presbycusis. The mean age of the study population was 68.4±6.3 years, with most patients belonging to the 60–69 years age group (35, 58.3%), followed by 70–79 years (19, 31.7%) and ≥80 years (6, 10.0%). There was a slight male predominance (34, 56.7%). All patients presented with gradually progressive bilateral hearing loss, while difficulty understanding speech in noisy environments was reported by 46 (76.7%), tinnitus by 27 (45.0%), and vertigo by 8 (13.3%) patients. Hypertension (28, 46.7%) and diabetes mellitus (20, 33.3%) were the most frequent comorbidities. Audiometric evaluation demonstrated bilateral symmetrical sensorineural hearing loss in all patients, with a high-frequency sloping audiogram observed in 42 (70.0%) patients.

Moderate hearing loss was the commonest degree (26, 43.3%), followed by moderately severe (16, 26.7%), mild (11, 18.3%), and severe hearing loss (7, 11.7%). Increasing age showed a significant association with hearing loss severity (p=0.003) and audiogram configuration (p=0.021), whereas gender was not significantly associated (p=0.714). Speech discrimination scores progressively declined with increasing severity of hearing loss (p<0.001), reflecting deterioration of both peripheral and central auditory processing with advancing age.

The age distribution observed in the present study is comparable with the findings of Harikrishna D et al.12 who also reported that presbycusis predominantly affected older adults, although their highest frequency was noted in the 50–55-year age group, suggesting relatively earlier presentation. Likewise, Sano H et al.13 studied patients aged 80 years and above and demonstrated that advancing age significantly influenced hearing thresholds and speech discrimination, indicating progressive auditory deterioration across older age groups.

Similarly, Sarin M et al.14 demonstrated a significant association between increasing age and high-frequency hearing loss (p=0.029), reinforcing that age remains the strongest determinant of presbycusis. While the present study showed a slight male predominance, Harikrishna D et al.12 observed more gently or steeply sloping audiograms among males, whereas flat audiograms were more common in females. In contrast, Sano H et al.13 reported better low-frequency hearing in males but better high-frequency hearing and speech discrimination among females, suggesting subtle gender-related variations in auditory aging despite the absence of significant gender differences in overall hearing severity in the present study.

The audiometric findings of the present study are closely comparable with those reported by Saqulain G et al.15 who identified high-frequency gently sloping audiograms as the predominant configuration and demonstrated a significant correlation between audiogram configuration and age, but not gender. Similarly, both studies showed that hearing loss severity increased significantly with advancing age while gender had no significant influence. Dansani UI et al.16 also reported moderate hearing loss as the most prevalent degree and observed declining speech discrimination scores with worsening hearing impairment, findings that parallel the present observations.

However, Sarafraz M et al.17 classified presbycusis according to pathological subtypes and found sensory presbycusis to be the commonest pattern, with tinnitus present in more than 60% of patients, a higher proportion than the 45% observed in the present study. Furthermore, unlike the present study, they did not find a significant association between presbycusis and hypertension, suggesting variability in vascular risk factors across different populations.

Recent studies have also emphasized the importance of individualized audiological assessment. Arthana IM et al.18 demonstrated that different audiometric configurations respond differently to hearing-aid optimization, with profile-specific amplification strategies improving speech recognition outcomes. Similarly, Sano H et al.13 reported that audiometric configuration, age, and hearing thresholds significantly influenced maximum speech discrimination scores, findings that complement the present observation of progressively declining speech discrimination with increasing hearing loss severity. The consistency of these findings indicates that deterioration in speech understanding is not solely dependent on pure-tone thresholds but also reflects neural and central auditory degeneration.

The overall agreement between the present study and previous investigations confirms that presbycusis is characterized by progressive bilateral high-frequency sensorineural hearing loss with advancing age, accompanied by declining speech discrimination. Minor differences among studies may be attributed to variations in age distribution, ethnicity, occupational noise exposure, associated systemic diseases, and methods of audiometric classification. These findings emphasize the importance of early audiological screening, comprehensive hearing assessment including speech discrimination testing, and timely auditory rehabilitation to preserve communication ability and improve the quality of life among older adults with presbycusis.

CONCLUSION

Presbycusis is a common age-related auditory disorder that predominantly affects older adults and significantly impairs communication and quality of life. The present study demonstrated that gradually progressive bilateral sensorineural hearing loss with a high-frequency sloping audiometric pattern was the predominant clinical presentation. Moderate hearing loss was the most frequent severity, and increasing age showed a significant association with worsening hearing impairment and reduced speech discrimination. Hypertension and diabetes mellitus were common associated comorbidities. These findings highlight the importance of early audiological assessment, routine hearing screening in the elderly, prompt identification of associated risk factors, and timely auditory rehabilitation to improve functional outcomes and overall quality of life.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

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